Composition of Moulding Sand

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Sources of Sand

- Sea Shores,
- Rivers,
- Lakes,
- Deserts and
- Granular Elements Of Rocks.

Moulding sands can be classified mainly into **two types namely natural or synthetic**.

- Natural molding sands contains sufficient amount of binder material.
- Whereas synthetic molding sands are prepared artificially using basic sand molding constituents (silica sand in 85-91%, binder 6-11%, water or moisture content 2-8%) and other additives in proper proportion by weight with perfect mixing and mulling in suitable equipment.

Constituents of Molding Sand

The main constituents of moulding sand involve **silica sand, binder, moisture content and additives.**

Silica sand

Silica sand in form of granular quarts is the main constituent of moulding sand having enough refractoriness which can impart strength, stability and permeability to molding and core sand. But along with silica small amounts of iron oxide, alumina, lime stone ($CaCO_3$), magnesia, soda and potash are present as impurities. The chemical composition of silica sand gives an idea of the impurities like lime, magnesia, alkalis etc. present. The presence of excessive amounts of iron oxide, alkali oxides and lime can lower the fusion point to a considerable extent which is undesirable. The silica sand can be specified according to the sand grain size and the shape (angular, sub-angular and rounded) of the sand.

Zircon sand

The following properties make zircon an excellent material for sand casting, investment casting, and die casting:

- Low acidity: its pH varies between neutral to slightly acid
- Clean and round grains allow the material to be easily bonded together
- Consistent fineness and ability to form fine grains
- High ability to bind with all organic and inorganic sand binders

Zircon sand

- Low thermal expansion coefficient and high spatial stability at increased temperatures
- High melting point (2,100 – 2,300℃)
- High thermal conductivity
- Chemical stability at high temperatures
- Low wettability by molten metal
- Good recyclability

Olivine Sand

Binder

Binders can be either inorganic or organic substance. Binders included in the inorganic group are clay sodium silicate and port land cement etc. In foundry shop, the clay acts as binder which may be Kaolinite, Ball Clay, Fire Clay, Limonite, Fuller's earth and Bentonite. Binders included in the organic group are dextrin, molasses, cereal binders, linseed oil and resins like phenol formaldehyde, urea formaldehyde etc. Binders of organic group are mostly used for core making. Among all the above binders, the bentonite variety of clay is the most commonly used. However, this clay alone can't develop bonds among sand grains without the presence of moisture content in molding sand and core sand.

Naturally bonded sands are used in gray iron, ductile iron, malleable iron, and nonferrous foundries (except magnesium). Synthetically bonded sands are produced by combining clay-free sand with precise amounts of clay or bentonite. They are more uniform than naturally bonded sands but require more careful mixing and control. Steel foundries, gray iron and malleable iron foundries, and magnesium foundries use this type of sand. For cores, or other sands that must harden enough to be an object that can be lifted or moved around, synthetic bonding is usually necessary.

Moisture

The amount of **moisture content** in the moulding sand varies from 2 to 8%. This amount is added to the mixture of clay and silica sand for developing bonds. This is the amount of water required to fill the pores between the particles of clay without separating them. This amount of water is held rigidly by the clay and is mainly responsible for developing the strength in the sand. The effect of clay and water decreases permeability with increasing clay and moisture content. The green compressive strength first increases with the increase in clay content, but after a certain value, it starts decreasing.

Additives

Additives are the materials generally added to the moulding and core sand mixture to develop some special property in the sand. Some commonly used additives for enhancing the properties of moulding and core sands are coal dust, corn flour, dextrin, sea coal, pitch, wood flour, silica flour.

Coal dust

Coal dust is added mainly for producing a reducing atmosphere during casting process. This reducing atmosphere results in any oxygen in the pores becoming chemically bound so that it cannot oxidize the metal. It is usually added in the moulding sands for making moulds for production of grey iron and malleable cast iron castings.

Corn flour

Corn flour belongs to the starch family of carbohydrates and is used to increase the collapsibility of the moulding and core sand. It is completely volatilized by heat in the sand mould, thereby leaving space between the sand grains. This allows free movement of sand grains, which finally gives rise to mould wall movement and decreases the mould expansion and hence defects in castings. Corn sand if added to moulding sand and core sand improves significantly strength of the mould and core.

Dextrin

Dextrin also belongs to starch family of carbohydrates that behaves also in a manner similar to that of the corn flour. Dextrin increases dry strength of the moulds.

Sea coal

Sea coal is the fine powdered bituminous coal which positions its place among the pores of the silica sand grains in moulding sand and core sand. When heated, sea coal changes to coke which fills the pores and is unaffected by water. Because of this, the sand grains become restricted and cannot move into a dense packing pattern. Thus, sea coal reduces the mould wall movement and the permeability in mould and core sand and hence makes the mould and core surface clean and smooth

Pitch

Pitch is distilled form of soft coal. It can be added from 0.02 % to 2% in mould and core sand. Pitch enhances hot strengths, surface finish on mould surfaces and behaves exactly in a manner similar to that of sea coal.

Wood flour

Wood flour is a fibrous material mixed with a granular material like sand. Wood flour is relatively long thin fibers prevent the sand grains from making contact with one another. Wood flour can be added in between 0.05 % to 2% in mould and core sand. Wood flour volatilizes when heated, thus allowing the sand grains room to expand. Wood flour will increase mould wall movement and decrease expansion defects. Wood flour also increases collapsibility of both mould and core.

Pulverized Silica or Silica flour

Silica flour is called as **pulverized silica.** Pulverized silica can be easily added up to 3% which increases the hot strength and finish on the surfaces of the moulds and cores. It also reduces metal penetration in the walls of the moulds and cores.